Oil Spill Response Research & Renewable Energy Test Facility

The Ohmsett Gazette

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EPA Bakken Crude Oil Study

The oil spill response industry constantly adjusts to emerging challenges from new oils being transported throughout the United States, whether onboard trains or through pipelines. To evaluate the risks a potential spill could pose on the environment and the best procedures for cleaning up a spill, the US Environmental Protection Agency (EPA) has undertaken the study of one of the new crude oils in the marketplace, Bakken crude, to define the risks of responding to a spill.

In February 2015 researchers from the EPA Emergency Response Team conducted evaluations at Ohmsett with the Bakken crude. According to Greg Powell, environmental scientist for the EPA, the primary objectives for the Bakken oil tests were to evaluate volatile organic compounds released into the atmosphere due to a Bakken crude oil spill. In addition, product skimming tests were conducted on unweathered and weathered crude to evaluate the effectiveness of mechanical recovery methods.

Within the Ohmsett basin, a spill zone was constructed large enough to allow the Bakken crude to naturally spread to the sur-

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With the Tank Renovations Completed, Ohmsett is Ready to Go

With the Ohmsett tank drained, technicians complete repair tasks before refilling the tank.

Ohmsett was a flurry of activity during the spring and summer with jack hammers, power washers, sandblasters, and welding torches as employees and contractors conducted scheduled maintenance and repairs on the 667-foot long test basin.

Every five years, the 2.6 million gallon test tank is drained so the interior can be inspected to identify and complete repairs. This year's maintenance was a little more intense with concrete repairs, and the refurbishment and replacement of major components of the cable drive system. This tremendous effort was accomplished within four months and the tank was filled and ready for scheduled testing in September.

Before the tank could be drained, a certified laboratory tested the basin water to ensure the water quality met New Jersey Department of Environmental Protection (NJDEP) discharge standards. With the NJDEP approval, 2.6 gallons of saltwater was discharged into the Sandy Hook Bay. It took seven days with the technicians working around-the-clock.

As part of the maintenance, deteriorated concrete in and around the basin was removed and replaced. The existing coating of the interior of the test basin was removed and the surface prepared for the application of a new epoxy coating. New seals were then installed in the expansion joints and new viewing windows.

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New Gel Technology That Swells as it Absorbs Oil

Can a floating gel be effective in cleaning up oil spills? That is the question Dr. Mike Chung of Penn State University, Department of Materials Science and Engineering came to Ohmsett to answer. Using absorbency materials similar to those found in diapers as inspiration, Chung and his research team decided to find out. Chung researched materials that could swell while absorbing oil instead of water; one that would remain cohesive on the surface of the water rather than disintegrating after being used. In a small tank on the basin deck, Chung and his researchers performed absorbency tests with the new technology called Petrogel.

The BSEE funded project (project 1034 on the BSEE website) was tested during the week of October 5-9, 2015 where Petrogel products were observed for absorbency and tested for their ability to collect oil from the water's surface.

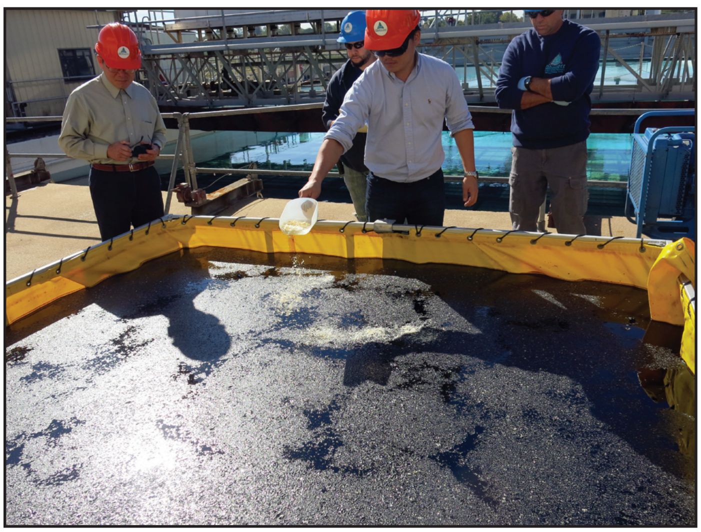
Prior to the absorption and skimming work, the two formulations of Petrogel at various levels of oil loading, were studied in the Ohmsett laboratory for viscosity change and basic rheology. Viscosity and rheology, the study of the reaction of fluids to an applied force, are important factors in predicting how a fluid will flow and spread, or how readily it may be transported by mechanical pumping.

For the operational tests, two Petrogel oil absorbents were used; one with a 1:1 rigid to soft polymer ratio and the other with a 3:1 rigid to soft polymer ratio. According to Chung, "Both Petrogel products are capable of absorbing ANS oil (10% weathered) more than 30-40 times by weight in the first two hours."

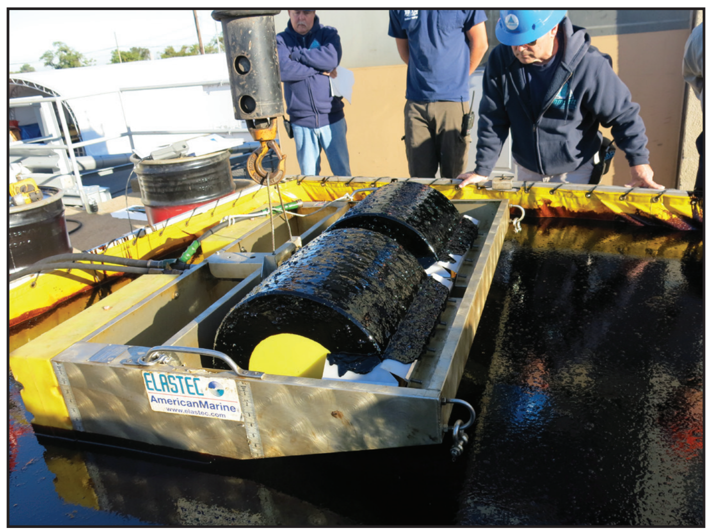
Experimenting with different amounts of Petrogel over one hour and 18 hour intervals, the products were tested in 10 x 10 foot tanks with Alaska North Slope (ANS) crude oil. "The Petrogel 1:1 ratio formed soft chunk-like gel after oil absorption, and absorbed slightly more ANS oil than the Petrogel 3:1 ratio that formed cohesive sheet-like gel," observed Chung.

After absorbing oil for each prescribed time frame, mechanical recovery tests were performed on the Petrogel using a drum skimmer to determine if it could be recovered from the water's surface. Several tests were performed where the recovered fluid was collected in the skimmer's sump with and without a pump connected to the skimmer. "The performance of both Petrogel products is quite consistent with the experimental results observed in our laboratory," commented Chung. "The Petrogel 1:1 ratio was effectively recovered by a drum skimmer. On the other hand, the Petrogel 3:1 ratio required some mechanical assistance to recover the viscous adducts by the drum skimmer."

At the conclusion of the testing Chung determined two outstanding issues that will need further investigation. First, which is the best Petrogel form that can be dispersed in water and spread by airplanes (like dispersants); second, testing how the recovered oil/Petrogel adducts can be refined by fractional distillion.



Experimenting with different amounts of Petrogel, the product was spread on crude oil and observed for absorbency.



Once Petrogel absorbed the oil, a drum skimmer was used to recover the product from the water's surface.

Tank Maintenance

Continued from page 1

In addition, the three traveling bridges, as well as the stairways and surrounding railings were refreshed with new paint.

In the final steps of the repairs, the main and vacuum bridges and ancillary equipment was placed back on the tank. With everything completed by the end of August the Ohmsett technicians worked around the clock for three days to refill the basin with water from the Sandy Hook Bay. The brackish bay water was filtered over several weeks to bring it back to crystal clear visibility and bulk salt was added to increase the salinity to that of ocean water necessary for testing.

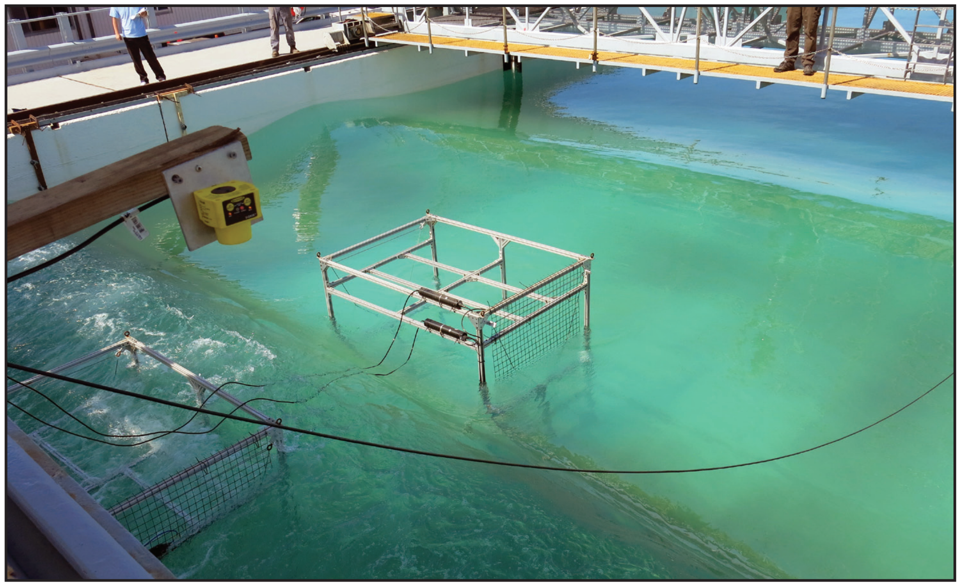
Making Waves Predictable and Reproducible

In an effort to develop a way to generate predictable and reproducible breaking waves in the Ohmsett test basin, BSEE funded a team of scientists and engineers from the New Jersey Institute of Technology (NJIT) to evaluate the ability of the wave generator to produce breaking waves at designated areas in the tank.

During the week of September 14, 2015, the team, led by Dr. Michel Boufadel, professor and director of the Center for Natural Resources and Development, set up instruments in the Ohmsett tank to gather data for improving the means of generating predictable and reproducible breaking waves. Having this ability will enable the Ohmsett staff and customers to quantify and compare the effect of the energy from these waves on oil mitigation systems and energy-capturing devices.

The instrumentation used during the evaluation included five acoustic doppler velocimeters (ADVs) placed on two frames in the zone of breaking waves to measure the 3-D water velocity profile. "The ADVs can provide 200 velocity measurements per second, and thus closely capture the hydrodynamics in the tank. The water profile (water surface) was monitored using two altimeters and numerous submersible cameras," said Boufadel. In addition, several ultrasonic wave height probes were placed over the test zone during measurements.

The team experimented with two methods for generating breaking waves at pre-set locations and time intervals, while collecting wave data to be analyzed with a fluid dynamics software program. "We considered first, a method that uses 32 wave components, but found the method too demanding considering the large size of the Ohmsett tank. Then, we used a method that relies on using only two wave components (a short wave and a long wave)," Boufadel explained. "This method is simple theoretically, but requires intimate knowledge of the peculiarities of the Ohmsett tank. Fortunately, the staff of MAR led by Mr. Alan Guarino and assisted by Mr. Joe Pucciarelli, provided such knowledge, and this enabled us to generate reproducible breaking conditions at desired locations in the tank (typically at mid-length)."



To study the ability to generate predictable and reproducible breaking waves, instrumentation was mounted on two frames and placed in the breaking wave zone of the test basin to measure the water velocity.

Also part of the test program was an assessment of the wave reflections from the tank's artificial beach system for possible improvements. The tank is equipped with a wave generator that can be programmed to produce varying types of waves. At the opposite end is a "beach" system that reduces reflection from the incoming waves. However, previous tests have shown that a considerable amount of reflection still occurs in the tank.

"The measurements needed for evaluating wave reflection were the water surface elevation and the water velocity as a function of time. Then, Fourier techniques were used to calculate the reflection characteristics from the time series," said Boufadel.

NJIT will use the data obtained from this research to design a physical grid-like barrier that could replace the present beach system to create drag and turbulence in the water, to dissipate the incoming wave energy. The grids could be raised or lowered as needed, and would be designed for easy cleaning and maintenance. Decreased reflection in the tank could better emulate natural ocean waves and make future oil spill response and energy harvesting technology tests more accurate and reproducible.

Development of Technology Readiness Level Definitions

Technical experts in the oil spill response field, testing laboratories, and government agencies met at Ohmsett on October 21 and 22 to discuss and develop technology readiness levels (TRL) for oil spill response technology and equipment development. This Bureau of Safety and Environmental Enforcement (BSEE) project was initiated to establish a uniform and objective means to determine the level of maturity of new technology, and when it is ready for use in the field.

According to Kimberly Bittler, a research specialist with the BSEE Oil Spill Preparedness Division, the workshop discussions centered on the definition of each technology readiness level and the technical criteria a technology must achieve during the development process in order to advance to the next readiness level. "A key concept of the TRL framework is that technologies are tested to specific applicable environments," said Bittler.

During the workshop, participants viewed a skimmer demonstration in a small fast tank. "The concept of TRLs and the applicable environment was demonstrated by the difference in skimmer performance based on the viscosity of oils," said Bittler. "In the main tank, participants observed an ongoing BSEE-led study comparing the performance of several commercially available dispersants that illustrated the different scales of testing encountered during the technology development process."

During the TRL Workshop, participants observed a skimmer demonstration that illustrated the difference in skimmer performance based on the viscosity of oils.

"The TRLs will give the response community a common language to compare the status of emerging technologies such as remote sensing tools, booms, and skimmers," explains Bittler. "This system will also facilitate direct and cost-effective development of promising new technologies. "

The final project is expected to be completed and available on BSEE's website in early 2016.

Ohmsett Wave Characterization Study

Ohmsett's test tank looked like it was wired for a scientists' experiment when researchers from the U.S. Naval Research Laboratory (NRL) conducted their wave characterization study. With instrumentation on the main bridge, the bridge house, the tank bottom and along the decks, the researchers calculated the mixing energy of the waves generated in Ohmsett's test tank during the BSEE funded study the week of September 21, 2015.

Why did they need to calculate the mixing energy of waves? Mixing energy is a key measurement parameter in dispersant effectiveness tests conducted in small and intermediate scale using methods such as the EPA baffled flask test.

NRL towed three MicroRiders turbulent sensors, as well as other instrumentation including ADVs, which sample turbulent velocity and temperature fluctuations in the test tank at different depths and in various wave conditions. While the MicroRider was collecting data, sonic wave height probes mounted above the surface of the tank, and a set of sensing packages on the bottom of the tank, characterized the background flow field in the tank. These flow fields included wave particle velocities, large-scale turbulent motions, and aeration associated with wave breaking conditions. The turbulent velocity-shear data recorded by the MicroRiders will be used to determine dissipation rate of the turbulent kinetic energy in order to quantify the dynamic process affecting dispersant effectiveness.

With the data collected during the study, researchers will be able to correlate dispersant effectiveness tests conducted at small scale with those conducted at Ohmsett.

Instrumentation is lowered into place during the wave characterization study.

Enhanced Oil Spill Detection Sensors in Low-Light Environments

If an oil spill occurs at night or in low visibility, can current technologies detect it? That is the question the Oil Spill Preparedness Division of Bureau of Safety and Environmental Enforcement (BSEE) set out to answer during recent research to identify and assess technology gaps in detecting oil spills.

Over the years technological advances have been made in the detection of oil spills. However, relying on time-delayed aerial remote sensing or visual observation, most technologies do not work well in low light or at night. In collaboration with the Special Products and Prototyping Division of US Army Night Vision and Electronic Sensors Directorate (NVESD), BSEE leveraged their expertise to test and evaluate military and state-of-the-art hardware to support the design, development and demonstration of new technologies to fill in the gaps.

Using current military and state-of-the-art night vision sensor technology and various crude oils, a research team from NVESD conducted day and night imaging experiments at Ohmsett. Over the course of several days in April 2015, the NVESD, BSEE and Ohmsett team took advantage of light levels ranging from full sun to partial moon light in order to evaluate the technology's ability to detect crude oil in a marine environment.

The experiments took place in a heated portable tank filled with salt water from the Ohmsett test tank. This tank acted as a heat sink to maintain uniform temperature of the water and oil. To prevent cross contamination of the oils, each one, at a known millimeter thickness, was placed in a separate container and placed in the tank.

To provide imagery and to detect oil under all light conditions, Long Wave Infrared (LWIR) thermal microbolometer, Short Wave Infrared (SWIR), and digital image intensified night vision cameras were setup on tripods overlooking the tank and oils. The team collected data during the afternoon, sunset and well into the night. Approximately every 5 minutes, they recorded the light level, water temperature, and collected imagery of the oil samples.

The experiments confirmed that certain times during the day and night are important for the highest contrast. "Analysis of the data showed that thermal crossover occurred for a long time, where the oil and water have the same apparent temperature," said Dr. Toomas Allik, president of Active EO. "This would be a bad time to look for spills with LWIR cameras on fixed wing, helicopter, ship and UAV assets, since the contrast is poor." At night the effect was reversed, the thicker oil had a lower apparent temperature and appears darker. Allik recommends conducting additional experiments with oil emulsions and filtered cameras.

The team concluded that while the LWIR, SWIR and intensified night vision cameras provided useful imagery and were able to detect oil under all light conditions, the thermal imagery from the LWIR camera proved to be the most beneficial for very thick oil spills. Standard CCD and CMOS cameras did not provide useful imagery beyond twilight. The thermal contrast differentials were seen based on oil thickness for most times during day and night. The LWIR camera provided quantitative oil analysis for crude oil slick thicknesses of 1 mm and above.

The US Army NVESD and Active EO team plan to publish additional technical details in 2016 at an international conference.

To provide imagery and to detect oil in different lighting conditions, Long Wave Infrared (LWIR) thermal microbolometer, Short Wave Infrared (SWIR), and digital image intensified night vision cameras were setup on tripods overlooking the tank and oils.

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face area significant enough to conduct air monitoring and sampling as well mechanical recovery testing. Detection and emissions monitoring equipment was positioned around the spill zone, and was supplemented with hand-held detection monitors for real-time measurements. With the assistance of the U.S. Coast Guard Atlantic Strike team, researchers conducted air monitoring and sampling throughout the series of tests for evaluation of hydrocarbons.

While continuous air sampling took place, Ohmsett technicians collected surface samples of the oil for laboratory analysis. Samples were taken at half-hour intervals for the first three hours, then hourly until the end of the work day. After the first day of testing, the Bakken crude oil remained on the test basin surface overnight. In the morning, the oil was sampled and then consolidated into a smaller area using the Ohmsett auxiliary bridge barrier. Once consolidated, an Elastec TDS-118 grooved drum skimmer was used to recover the oil.

On the second day, stationary recovery tests with the Elastec TDS-118 were conducted using the ASTM F2709 "Standard Test Method for Determining Nameplate Recovery Rate for Stationary Skimmer Systems" to determine the recovery rates and corresponding recovery efficiencies. A boomed test area was setup in the test basin where the weathered oil was added to create a slick. Following this series of tests, another series was conducted using fresh crude. "Skimming tests on fresh Bakken oil achieved an average recovery rate of 5 gpm while oil that was weathered for 24 hours was recovered at a rate of 20 gpm," commented Powell.

After the skimmer tests were performed, 60 gallons of the crude oil was distributed into the skimmer test area for further weathering. Samples were taken two and five days later to analyze the oil properties in the laboratory.

The information collected during this evaluation will be used to support response plans for responder safety, as well as effective oil recovery procedures to protect the environment.

A spill zone of Bakken crude oil was created in the test basin for air monitoring and sampling, as well as mechanical recovery testing.

Oil Spill Response Strategies & Tactics Training

May 24-26, 2016
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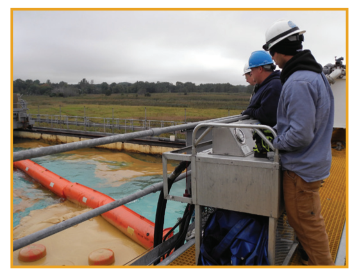

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News Briefs

A Fond Farewell as Bill Schmidt Retires

After 19 ½ years as facility manager, Bill Schmidt is retiring at the end of December. During his tenure, Schmidt has fostered a dedicated and knowledgeable staff of 19 from an original team of nine, and developed Ohmsett into a world renowned oil response testing and training facility.

When he started in March 1996, the facility was only available for testing from May to September. "The first goal was to find a way to get beyond a 70 day test schedule," said Schmidt. By instituting major upgrades, such as rebuilding the filter system, installing an oil/water separator, establishing the first tank refurbishment and adding a 30-seat classroom for the US Coast Guard and Texas A&M National Spill Control School classes, in less than five years Ohmsett was able to go from being available for less than six months for testing, to offering a full year testing schedule.

With no official way to communicate to the oil spill response community, Schmidt and his team established the Ohmsett Gazette and website in 1998. "No one knew Ohmsett was back in service," said Schmidt. "We needed to get the word out to the folks that we were an operational facility. The first newsletter went out to over 3000 people." Schmidt and staff engineers joined the ASTM Committee on Hazardous Substances and Oil Spill Response, and started the process of developing standard testing protocols that were approved by the committee and have become the benchmark for the industry. Under his guidance the staff also started attending conferences and eventually presenting papers at conferences and industry workshops, as well as advertising in industry publications.

As the test schedule increased, so did the major upgrades to the facility. Over the years, Schmidt supervised multiple upgrades which included a new filtration system, computerized wave generator, bridge drive system, tank farm, permanent oil/water laboratory, new storage building, and new auxiliary bridge.

One of the many significant activities that occurred during his tenure was the Wendy Schmidt Oil Cleanup X CHALLENGE. This competition required the largest volume of oil ever used in more than four decades of testing at Ohmsett.

In 2012, with much of the area and facility devastated during Hurricane Sandy, Schmidt led his team through the recovery process to get the facility online within four weeks. "The staff was very dedicated throughout the whole process. Our vendors, who we've worked with over the years came to our aid and made it possible to resume testing in a short period of time."

With his final tank refurbishment project behind him, Schmidt has the accomplishment of taking a facility built in the 1970s with the ability to only test 70-80 days out of the year, to a state-of-the-art facility that reached a record of 184 test days.

"BSEE has been fortunate to have Bill's continued support and expertise," say David Moore, chief of the Oil Spill Preparedness Division for the Bureau of Safety and Environmental Enforcement. "Having Bill on-site has allowed us to be confident that Ohmsett is being operated in full compliance with the Oil Pollution Act of 1990."

Because of Schmidt's vast knowledge of the facility's capabilities, he will remain as a part-time employee to assist in marketing efforts.

Ohmsett program manager Bill Schmidt will retire this month. As part of the Community Outreach program for Ohmsett, Bill Schmidt would often conduct facility tours for government agencies, as well as university and high school groups.

The Ohmsett Gazette is published biannually by Ohmsett -The National Oil Spill Response Research & Renewable Energy Test Facility to update our readers on activities at the facility.

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